

FIG. 1

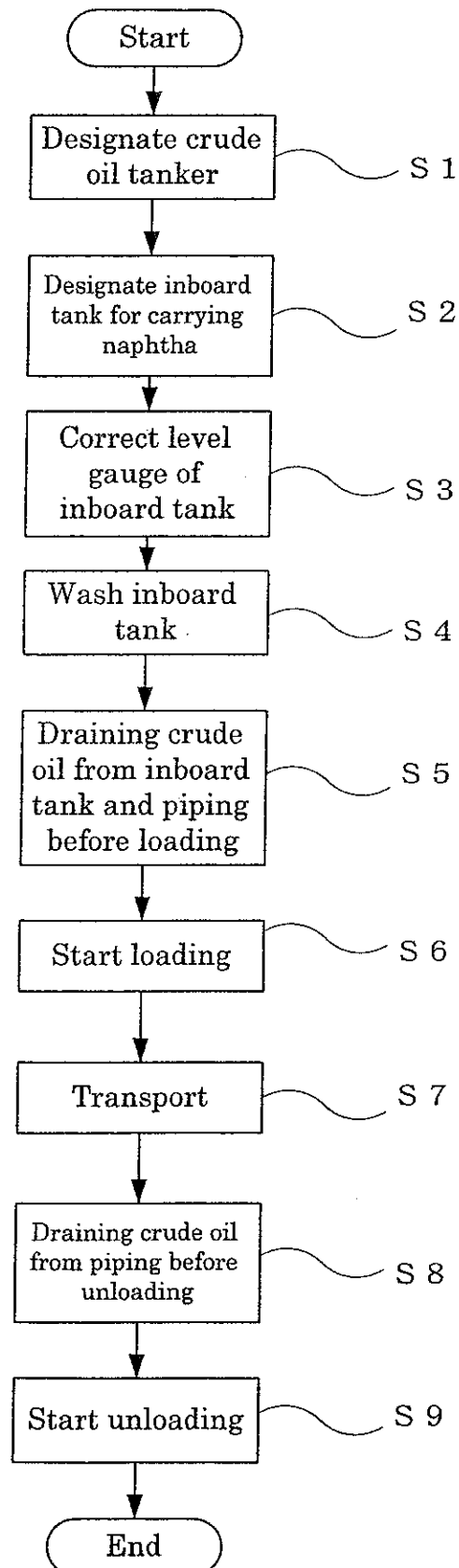


FIG. 2

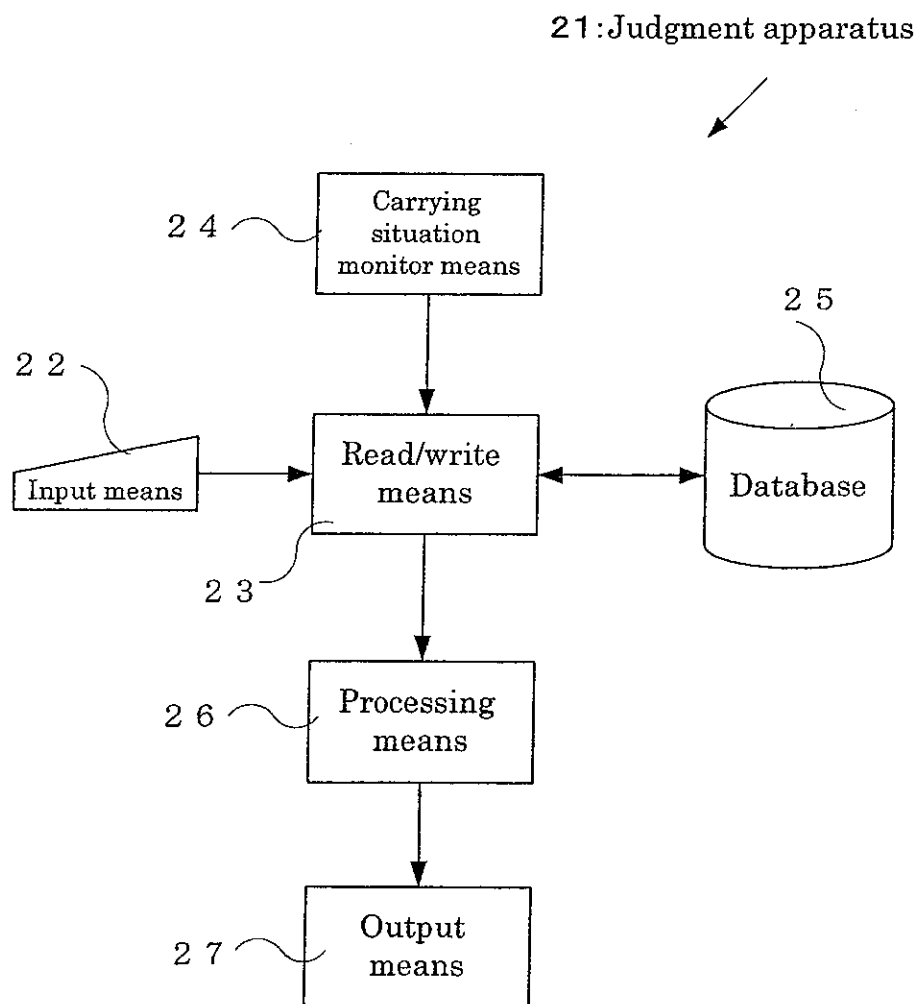


FIG. 3

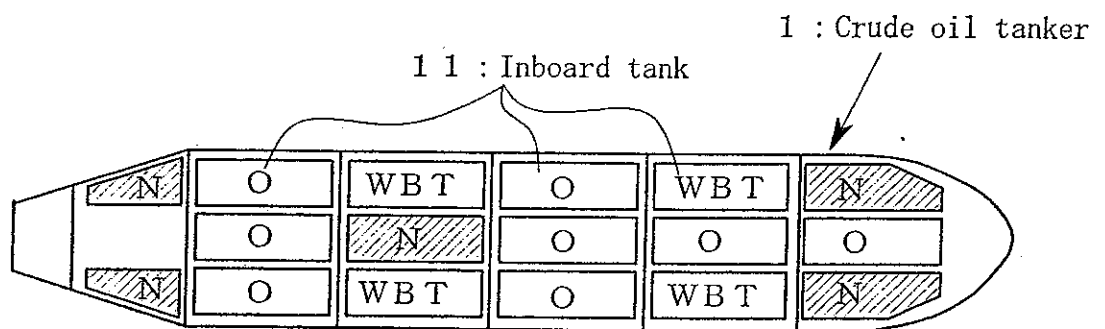


FIG. 4

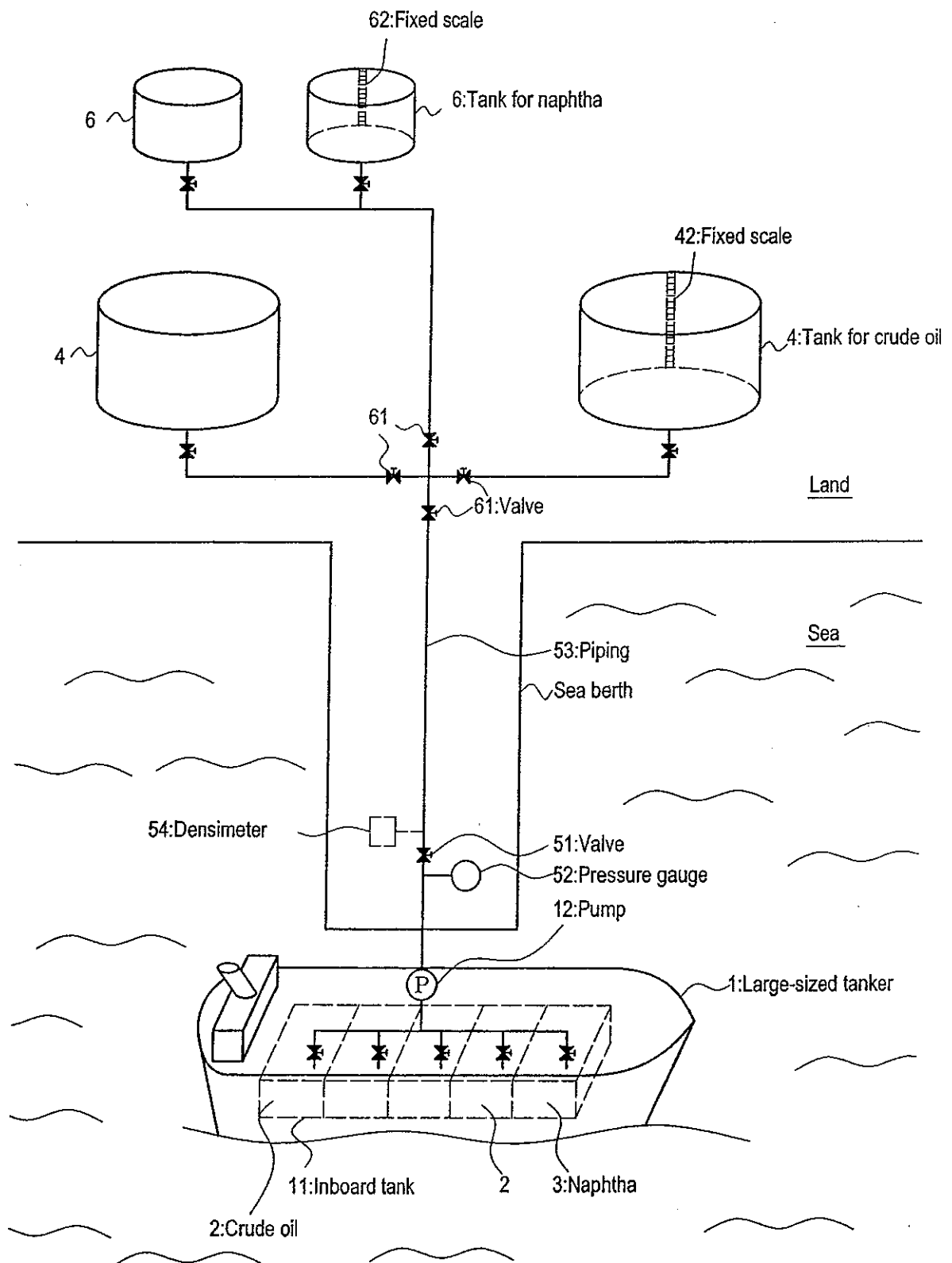


FIG. 5

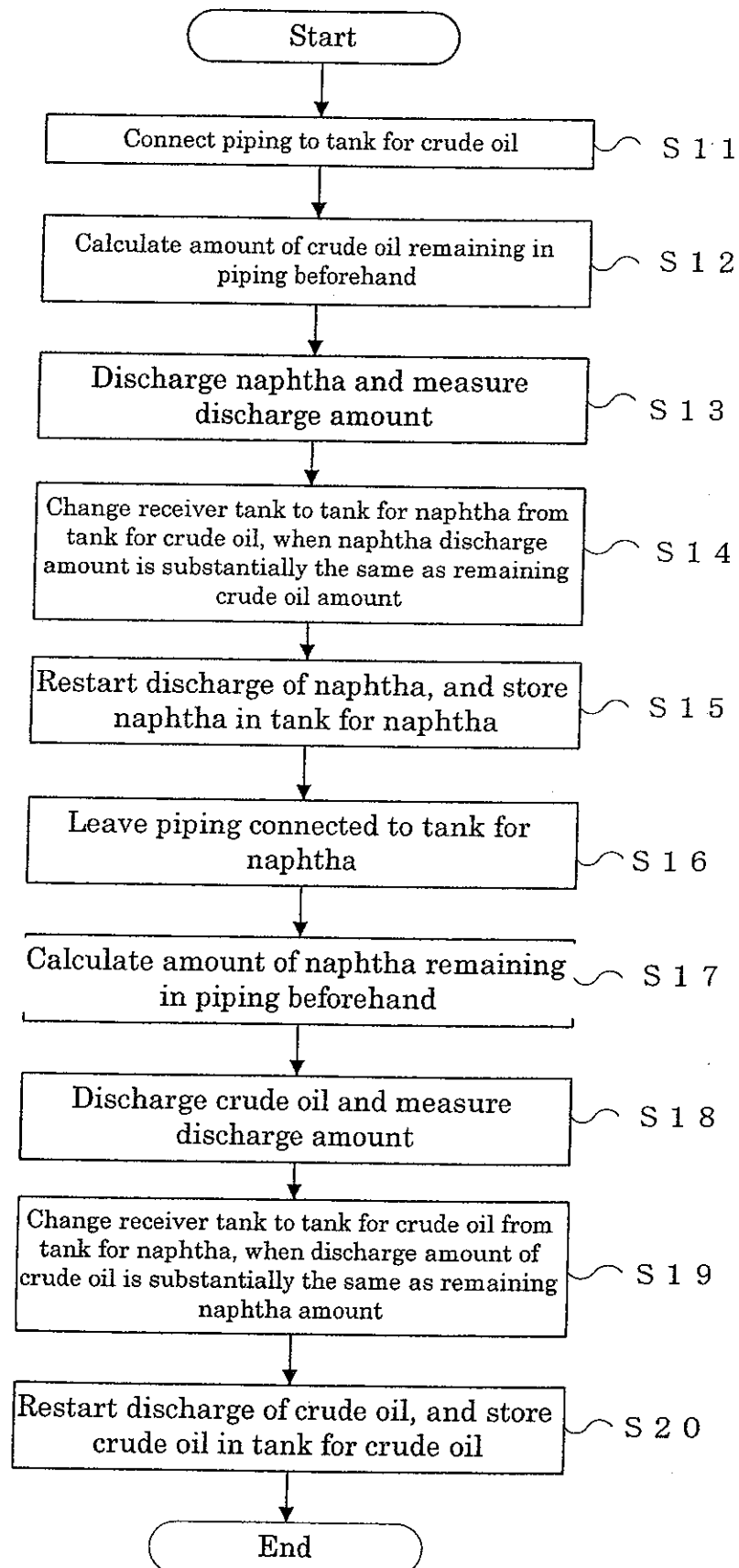


FIG. 6

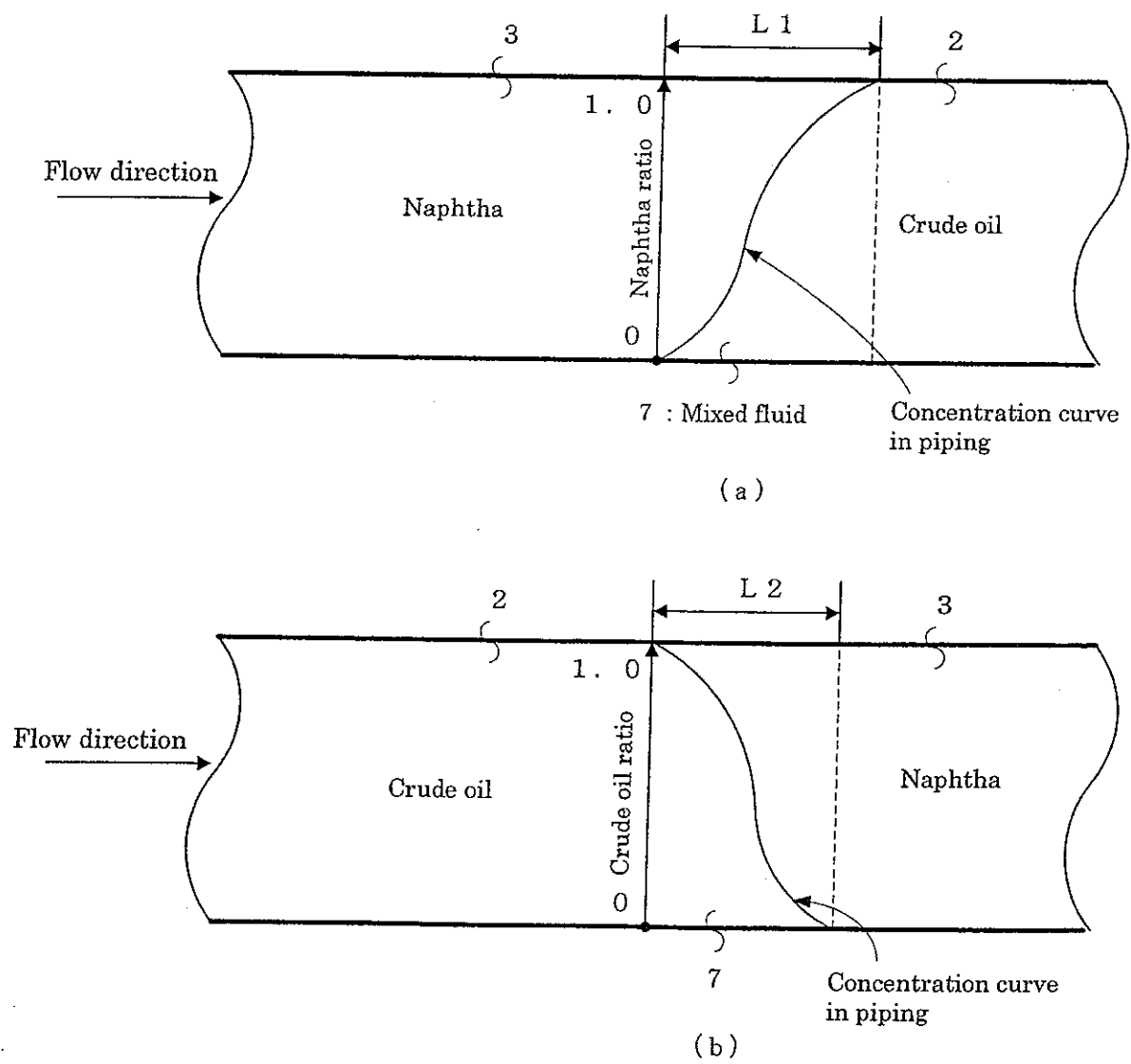


FIG. 7

|                                                                                                                                                                                                                                   |     |                           |                                         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|---------------------------|-----------------------------------------|
| $\frac{\partial U_i}{\partial x_i} = 0$                                                                                                                                                                                           | (1) | Continuity equation       | $U_i$ : Flow rate component             |
| $\frac{\partial U_i}{\partial t} + U_j \frac{\partial U_i}{\partial x_j} = -\frac{1}{\rho} \frac{\partial p}{\partial x_i} + \frac{\partial}{\partial x_j} \left( \nu \frac{\partial U_i}{\partial x_j} - u u_j \right) + g_{ie}$ | (2) | Momentum equation         | $u_i$ : Speed scholar amount            |
| $-u u_j = \left( \nu \frac{\partial U_i}{\partial x_j} - \frac{2}{3} \kappa \delta_{ij} \right)$                                                                                                                                  | (3) | Turbulence model equation | $\nu$ : Kinetic viscosity               |
| $-u_i \phi = \Gamma_i \frac{\partial \phi}{\partial x_i}$                                                                                                                                                                         |     |                           | $\Gamma_i$ : Eddy diffusion coefficient |
| $\frac{\partial C_i}{\partial t} + U_j \frac{\partial C_i}{\partial x_j} = \frac{\partial}{\partial x_j} \left( \lambda \frac{\partial C_i}{\partial x_j} - u C_i \right) + S_e$                                                  | (4) | Diffusion equation        | $\lambda$ : Diffusion coefficient       |
|                                                                                                                                                                                                                                   |     |                           | $P$ : Pressure                          |
|                                                                                                                                                                                                                                   |     |                           | $\rho$ : Density                        |
|                                                                                                                                                                                                                                   |     |                           | $\varepsilon$ : Dissipation ratio       |
|                                                                                                                                                                                                                                   |     |                           | $k$ : Turbulent energy                  |
|                                                                                                                                                                                                                                   |     |                           | $\beta$ : Buoyancy coefficient          |
|                                                                                                                                                                                                                                   |     |                           | $C_i$ : Concentration                   |
|                                                                                                                                                                                                                                   |     |                           | $C_{1-3}$ : Empirical coefficient       |
|                                                                                                                                                                                                                                   |     |                           | $C_{*i}$                                |

$$\begin{aligned}
 \nu &= C_* \frac{k^2}{\varepsilon} \\
 \frac{\partial k}{\partial t} + U_j \frac{\partial k}{\partial x_j} &= -\frac{\partial}{\partial x_i} \left[ u_i \left( \frac{u u_j}{2} + \frac{P}{\rho} \right) \right] - u u_j \frac{\partial U_i}{\partial x_j} - \beta g u_i \phi - \nu \frac{\partial u_i}{\partial x_j} \frac{\partial u_i}{\partial x_j} \\
 \frac{\partial \varepsilon}{\partial t} + U_j \frac{\partial \varepsilon}{\partial x_j} &= \frac{\partial}{\partial x_i} \left( \frac{\nu}{\sigma_\varepsilon} \frac{\partial \varepsilon}{\partial x_i} \right) + C_1 \frac{\varepsilon}{k} (P + C_3 G) - C_2 \frac{\varepsilon^2}{k}
 \end{aligned}$$

Standard k-ε model

FIG. 8

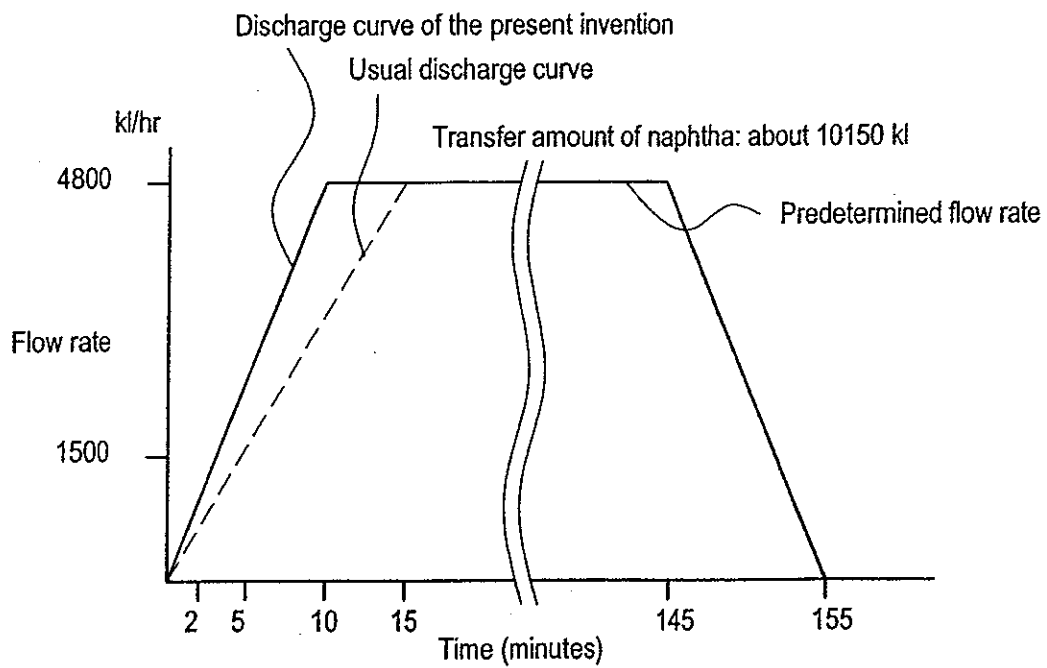
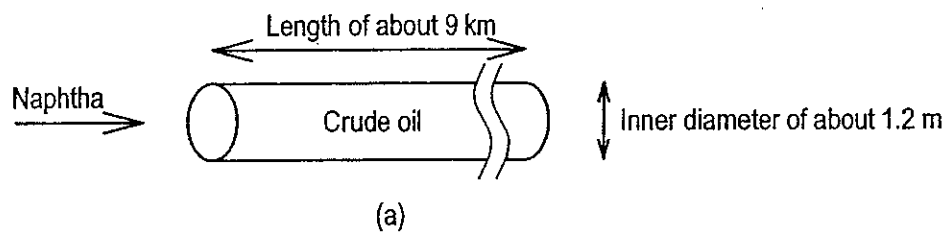


FIG. 9

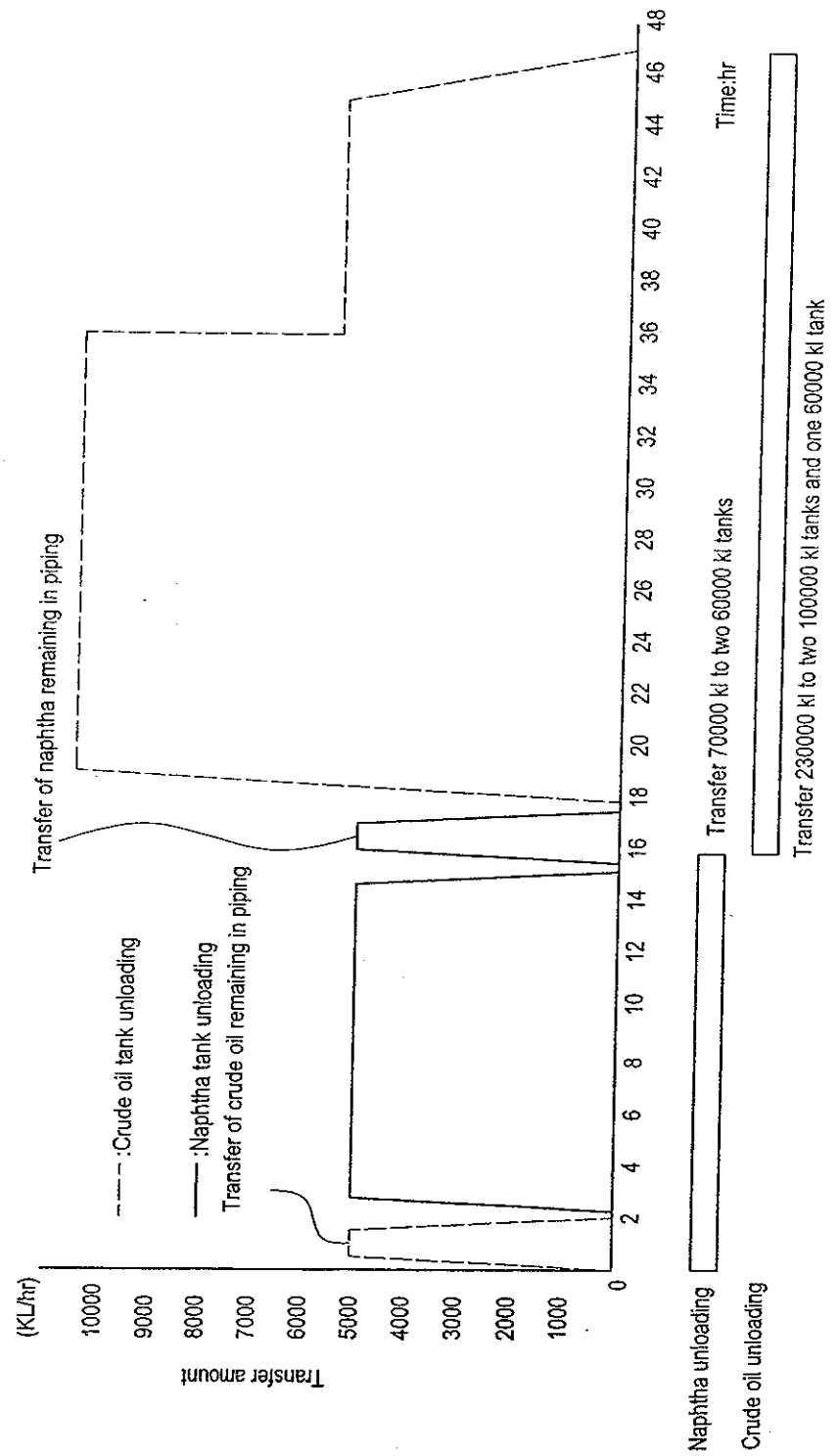


FIG. 10

